or more conducting electrodes, wherein the electrical drive comprises a first frequency component in a frequency range between 1 Hz and 1000 Hz. The capacitive coupling and electrical drive are dimensioned to produce an electro-sensory sensation, independently of any mechanical vibration of the one or more conducting electrodes or insulators.

[0010] As stated earlier, the touch input section comprises presence-detecting means for detecting a presence or absence of a user's body member near the at least one touch-sensitive area. The tactile output section according to the invention is operatively coupled to the presence-detecting means and comprises stimulus-variation means, such that the stimulus-variation means are configured to receive an input from the presence-detecting means and to temporally vary the electro-sensory stimulus based on input from the presence-detecting means. The stimulus may be varied by varying one or more of the electrical parameters defining it, including drive voltage, frequency or the capacitive coupling.

[0011] The significance of such a stimulus-variation means may not be immediately apparent. Yet the stimulus-variation means provides a clear benefit, for the following reason. Touch input devices, such as touch-sensitive displays, may provide a large number of distinct predefined areas. In some cases, the number of distinct predefined areas roughly equals the size of the touch-sensitive display divided by the size of a typical fingertip. For example, a modern smart phone may provide up to 20 distinct predefined areas, or even more, in its touch-sensitive display. The invention aims at eliminating or reducing the need to see the touch-sensitive display, in order to identify the distinct predefined areas. As regards the inventive tactile output section, however, it may be technically challenging to match the spatial resolution of the touch input section. The significance of the stimulus-variation means will be easiest to understand by assuming that the user touches the touch-sensitive display by only one finger at a time. Information on the area touched by the user's finger is detected by the presence-detecting means and relayed to the stimulus-variation means. The stimulus-variation means utilizes this information, such that touching different areas by the finger causes different electro-sensory stimuli to the finger. This means that tactile output section of the inventive interface apparatus may utilize relatively coarse spatial resolution and good temporal resolution to create an illusion of a spatial resolution that matches that of the touch input section. Under the assumption that the user touches the touch-sensitive display by only one finger at a time, even one electrode suffices to create an illusion of a much higher spatial resolution. In reality, the entire surface of the electrode provides the same stimulus intensity, but by varying the stimulus intensity based on information of the area touched by the user's finger, the inventive interface apparatus creates an illusion of multiple areas, each of which provides a distinct stimulus intensity. Such feedback may be provided by the interface section of device itself and/or the application-level program and/or the API that couples the application-level program to the interface device. Thus the inventive interface apparatus is capable of creating an illusion of a tactile output section with a spatial resolution exceeding its actual spatial resolution. An advantage of this feature is that the number of electrodes can be quite small, sometimes as low as one. The required number of electrodes equals the number of simultaneous, individually controlled stimuli. If, say, the tactile output section needs to create an individually controllable stimulus for each of two halves of the touch surface, two electrodes are sufficient. In many applications the user touches the touch surface with only one fingertip at a time, which means that one tactile output electrode suffices to create an illusion of a spatial resolution equal to that of the touch input section. Accordingly, the electrode (s) may be quite large, such as over 5 mm in both dimensions, up to the full size of the touch surface.

[0012] In an illustrative example, the electro-sensory stimulus is more intensive within the touch-sensitive areas. It is not necessary for the intensity of the electro-sensory stimulus to vary in precise accordance with the border(s) of the touch-sensitive area(s). For instance, assuming that the size and shape of the touch-sensitive areas correspond to a typical fingertip, it suffices to provide an intensity peak for the electro-sensory stimulus at the centre of each touch-sensitive area.

[0013] As an alternative to a comprehensive two-way interface apparatus which comprises the touch input section and tactile output section as described above, the invention can also be embodied as an upgrade to existing touch input devices. Accordingly, another aspect of the invention is a tactile output device, which comprises all features of the tactile output section as defined in claim **1**. The tactile output device is adapted for installation into a touch input device comprising all features of the touch input section as defined in claim **1**, such that installation of the tactile output device into the touch input device results in the interface apparatus according to claim **1**.

[0014] The usage of the terms "interface apparatus", "device" and "section" is such that "apparatus" refers to a comprehensive two-way interface apparatus which comprises the touch input section and tactile output section. In other words, the two "sections" are portions of the comprehensive two-way interface apparatus. On the other hand, the word "device" is used in contexts where the tactile output device is provided separately, for upgrading an existing touch input device. Thus the terms "section" and "device" are functionally interchangeable, and the difference between them is such that "sections" form parts of a comprehensive apparatus, while "devices" may be sold separately, such that an inventive tactile output device may upgrade an existing touch input device such the upgrading results in an inventive interface apparatus.

[0015] The invention solves or at least alleviates the problems associated with prior art touch screen interfaces by providing the user with a spatially variant electro-sensory stimulus, wherein the spatial variations of the electro-sensory stimulus are based on the layout of the touch-sensitive areas of the touch screen interface. The expression "are based on" refers to the fact that a touch screen interface may comprise up to three superimposed layouts: a first layout defines the touch-sensitive areas, a second layout defines the spatially variant electro-sensory stimulus according to the present invention, while a third layout defines the visual cues which in prior art devices help the user see the layout of the switch matrix. The third layout (the visual cues), which is virtually mandatory in prior art devices, is optional in the inventive touch screen interlace because its function can be delegated to the inventive second layout, namely the spatially variant electro-sensory stimulus. Naturally, all the two or three layouts should correspond to one another but absolute precision is not required, so long as no confusion arises regarding which touch-sensitive area is currently activated.

[0016] Touch screen interfaces are frequently used in connection with equipment in which the keyboard or keypad